Ministry of the Environment

Ontario

Water Resources
Map 3112

Ground Water Probability

County of Haldimand

GROUND WATER PROBABILITY
HALDIMAND COUNTY

DESCRIPTIVE NOTES

INTRODUCTION

Excluding industrial use, ground water is the source for about half of the water supply in the County of Haldimand. The Town of Caledonia and the Village of Hagersville are two of the principal municipal users of ground water. Private well supplies in many areas are supplemented by the use of cisterns, because of the high mineral content of the water. Other municipalities, some industries and other private systems obtain their supplies from surface sources mostly from Lake Erie and the Grand River.

This publication provides a ready guide on ground-water conditions in the County of Haldimand and has been prepared to assist those who wish to construct water wells. The map shows the probable quantity of water that may be obtained from the most commonly developed water-bearing formations in the county, the depth of these formations and the quality of water at sampled locations.

The ground-water probability map was compiled from nearly 1600 water-well records on file with the Ontario Ministry of the Environment, oil and gas well data compiled by the Petroleum Resources Section of the Ontario Ministry of Natural Resources, and from several studies of the

ground-water resources of various parts of the county.

USE OF PROBABILITY MAP

A prospective well site can be evaluated by the following steps:

1. Locate the area of the proposed well site on the map.

2. Note the depth from ground level to the top of the main or most commonly used water-bearing formation by referring to the contour lines.

3. Check the probable well yield by referring to the colour legend.

4. Determine whether the aquifer is in the rock or overburden by comparing the depth to the top of the aquifer with the thickness of overburden which is shown on Map 3112-3.

5. Check the likely water quality by locating nearby sampling points and checking the appropriate analyses in the tables; for overburden wells use Table 1 and for bedrock wells use Table 2.

6. If the aquifer is in the rock, the type of rock may be determined by locating the proposed well site on Map 3112-2 and by referring to the legend.

Probability Ranges

Yields are indicated in four ranges:

less than 2 gpm-inadequate to marginal for most purposes

2-10 gpm-marginal to adequate for domestic or stock purposes

10-50 gpm-adequate for most commercial, small industrial and farming purposes

greater than 50 gpm-adequate for most irrigative and many industrial and municipal purposes.

An area was placed in a certain probability range if more than 50 per cent of the wells in that area had calculated yields within the range. A well may not necessarily produce within the range indicated for its location but there is a better than 50 per cent chance that it will. The ranges were determined from reported, short-term pumping tests and do not necessarily represent long-term yields. If reliable well and aquifer yields are required, detailed hydrogeologic investigations and test pumping should be undertaken.

The depth from land surface to the top of the main or most commonly used water-bearing formations are more accurate where the land surface is flat than in the valleys of the larger streams where rapid changes in ground elevation made contouring more difficult.

The two cross-sections, along lines A_1-A_5 and B_1-B_4 show the major overburden and rock materials, depths where water was found, static water levels, depth to the bedrock, and penetration into the bedrock. They provide a general picture of the nature of the geologic deposits and the locations of water-yielding horizons beneath the land surface.

Water quality samples were taken from wells which represent the most commonly used overburden and bedrock aquifers. Different symbols distinguish the overburden wells from the bedrock wells. The analyses were done by field kit and at the Ministry's laboratory. The major chemical parameters for samples having comprehensive chemical analyses are shown at the sampling locations.

HYDROGEOLOGY

Geology

Sedimentary rocks of several formations underlie the overburden in the County of Haldimand. Map 3112-2 shows the bedrock geology and topography. The oldest rocks underlie the overburden in the northernmost part of the county. In the mid-northern and northeastern parts of the county the Upper Silurian, Salina Formation forms the bedrock. The rocks of the Salina Formation consist of tan dolomite, minor limestone, grey and red shale, small beds and lenses of anhydrite or gypsum and salt. Further to the south, in a band about a mile wide, the brown dolomites of the Upper Silurian, Bass Island Formation comprise the bedrock. In a small

area about halfway between Hagersville and Cayuga, grey sandstones of the Lower Devonian, Oriskany Formation underlie the overburden. In the mid-southern and south-eastern parts of the county, the brownish grey, cherty limestones of the Middle Devonian, Bois Blanc Formation form the bed-rock. In some areas the lower part of this formation contains sandstone beds. In the southwestern part of the county the bedrock consists of light brown limestone with some chert of the Dundee Formation of Middle Devonian age.

Most of the overburden is composed of glacial drift; mainly clays and clay tills, and some buried sand and gravel deposits. The thickness of overburden varies from 0 (there are many outcrops along Sandusk, Dry, Stoney and Hemlock creeks, at the Onondaga escarpment and along the banks of Lake Erie) to a depth of at least 170 feet in the Township of Moulton.

Geomorphologically one of the main features in the county is the Onondaga escarpment. It is capped by Devonian lime-stone and runs in an easterly direction from Hagersville to the northern shore of Lake Erie; several sections are buried under clay. The lower course of the Grand River is controlled by the escarpment.

The Haldimand clay plain covers a large part of the county. It is likely that most of the clay plain was formed by glacial Lake Warren . In the area northeast of Dunnville, sandy deposits cover the clay plain. These sands are likely deltaic deposits of the

Grand River. In the northern part several drumlins protrude above the clay plain. Some drumlins are partially buried. Relief is generally low in the county; noticeable relief occurs at the escarpment, in the drumlin fields and in the valleys of the Grand River and other streams.

Occurrence of Water

About 87 per cent of the recorded wells in the county obtain water from the bedrock. There are no extensive, shallow, overburden aquifers in the county; however, spotty, shallow aquifers are tapped by dug wells in many areas mostly in the southern half of the county. Most dug wells are not recorded.

South of the Onondaga escarpment where the overburden is generally very thin, almost all wells terminate in the bedrock. Others, especially the deeper ones, may penetrate more than one water-bearing horizon. In the majority of these cases, however, the water of the lower horizons is described as sulphurous or mineral water.

In the area north of the escarpment the overburden is thicker and attains its greatest average thickness in the Township of Moulton. In many areas the base of the overburden contains water-bearing sand and gravel layers in which wells are developed. Many rock wells obtain water in the upper few feet of the bedrock. Water quality analyses from bedrock and overburden wells show no great difference in chemical quality and they seem to suggest that the upper part of the bedrock and the lower part of the overburden are hydraulically interconnected.

While ground water is available in sufficient quantity in most parts of the county, its chemical quality in most cases is considerably poorer than that recommended for drinking water. Only about three per cent of the recorded wells were reported as dry.

Water Quality

The results of 96 laboratory analyses of water quality are listed in tables 1 and 2. Table 1 contains analyses from 72 bedrock wells and Table 2 the analyses from 20 overburden wells, 2 cisterns and one sample each from Lake Erie and the Grand River. Field analyses for H_2S and pH were done on 77 samples.

Scaled diagrams indicate the locations and the concentration of selected water-quality parameters for 86 samples. These diagrams show the concentrations of 6 major chemical water-quality parameters in milliequivalents per litre (meq/l) and the total dissolved solids in milligrams per litre (mg/l). The primary function of these diagrams is to present a pictorial comparison of analyses with the objective of identifying or emphasizing differences and similarities.

In order to aid comparison with water that would meet selected criteria for drinking water, a criteria limits diagram has been developed as follows: the right-hand side shows the recommended criteria for the maximum content of sulphates and chlorides in drinking-water supplies in Ontario and a limit for bicarbonate (HCO_3) based on a criterion accepted by several public agencies. The recommended figures

are 250 mg/l (7 meq/l) for chlorides (Cl), 250 mg/l (5.2 meq/l) for sulphates (SO_4)and 500 mg/l (8.2 meq/l) for bicarbonate. Although not shown in the diagram the total amount of anions considered in balancing the criteria limits diagram includes the recommended maximum concentration of 45 mg/l (0.7 meq/l) for nitrates (as NO_3). The left-hand side of the diagram uses 200 mg/l (8.7 meq/l) for sodium (Na) which is an accepted limit in literature; the value for the remaining cations which was obtained by balancing cations and anions, was distributed between calcium (Ca) and magnesium (Mg) in the ratio of 2:1. This ratio is within generally accepted ratios for calcium and magnesium in naturally occurring water. The criteria limits for the above parameters result in a sample of water having a total dissolved solids value which exceeds the recommended limit of 500 mg/l for drinking water. In practice it has been found that if one of the recommended criteria is exceeded, the recommended limit for total dissolved solids will also be exceeded.

The schematic criteria limits diagram constructed on the legend of the map indicates a total dissolved solids limit of 1000 mg/l. By comparing the diagrams for the samples taken with the criteria limits diagram, the user can determine which criteria are exceeded.

The quality of ground water is generally poor in the county. Very high total

dissolved solids content, mainly due to high sulphate content, is characteristic of the ground-water quality. Table 3 is a comparison of the water-quality analyses in the county from wells terminating in the overburden and in three major bedrock units: the Salina and Bass Island formations and the limestones of the Devonian, Bois Blanc and Dundee formations.

The worst quality water is found generally in areas where the Salina Formation is the bedrock. In these areas water from the overburden has as poor quality as water from the Salina bedrock. The majority of the wells in these areas yield water with more than 2500 mg/l total dissolved solids and 1000 mg/l of sulphates. These values are the upper limits of recommended water-quality criteria in Ontario for livestock use.

In the southern part of the county the water quality is somewhat better; however, the value of total dissolved solids exceeds the recommended value of 500 mg/l in most areas. For comparison with ground water, water quality analyses from two cisterns, Lake Erie and the Grand River are listed in Table 1.

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CHEMICAL ANALYSES OF WATER SAMPLES

Table 1. Laboratory Analyses—Overburden Wells

Sample or Well No.	Date	H_2S at Field	pH at Field	pH at Lab	Constituents in milligrams per litre (mg/l)												Sodium Adsorbtion Ratio	Alkalinity as mg/l $CaCO_3$	Total Hardness as mg/l $CaCO_3$	Total Disolved Solids mg/l	Specific Conductance (micromhos at 25°C)
					Total Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Boron (B)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (N)					
Lake Erie	20/7/72	0.0	8.1	8.3	0.10	46	4	12	1.2	<0.02	0	119	27	27	0.1	<0.01	0.46	98	132	230	319
Grand River	9/11/72	—	—	8.2	0.70	98	22	16	3.0	—	—	270	103	31	—	3.1	0.38	221	336	460	—
C-1 (cistern)	17/7/72	0.0	7.2	7.8	0.15	14	1	1	0.3	<0.02	0	34	8	2	0.2	0.86	0.07	28	40	70	82
C-2 (cistern)	28/11/72	—	—	8.2	0.05	26	7	<1	4.8	—		80	20	4	—	<0.01	0.05	66	92	120	—
26-50	18/7/72	Trace	8.0	7.6	5.2	632	121	304	9.6	8.0	0	44	1862	572	—	0.20	2.90	36	2080	3900	4393
26-70	7/6/72	0.0	7.5	—	0.35	508	129	172	3.9	0.64	0	69	2000	21	1.2	<0.01	1.76	57	1800	3130	3105
26-88	15/6/72	Trace	7.7	7.6	2.4	512	153	158	3.7	2.14	0	78	1700	51	1.4	<0.01	1.57	64	1910	3150	3130
26-244	15/6/72	0.2	7.7	7.2	2.3	520	118	188	7.5	0.82	0	80	1840	59	1.2	0.16	1.94	66	1790	3090	3266
26-257	6/6/72	0.0	7.5	—	0.65	556	129	300	6.2	1.70	0	40	2100	197	1.2	0.01	2.98	33	1920	3600	3780
26-308	9/6/72	1.5	7.2	—	5.7	504	219	82	5.2	0.49	0	301	2000	14	1.0	0.01	0.77	247	2170	3260	3265
26-390	8/6/72	0.0	6.7	—	0.25	632	83	37	3.2	<0.1	0	438	1400	38	0.9	5.0	0.37	359	1920	2670	2726
26-440	14/6/72	0.0	7.1	7.1	16	440	54	11	1.7	<0.17	0	305	950	9	0.5	0.01	0.13	250	1350	1780	1897
26-465	16/6/72	2.0	7.2	7.0	5.5	580	54	32	2.1	<0.25	0	351	1350	48	0.9	0.01	0.34	288	1680	2410	2641
26-759	17/7/72	0.0	7.3	7.5	0.85	624	73	110	9.0	2.00	0	80	1890	49	1.4	0.10	1.11	66	1860	3050	3100
26-787	15/1/73	Trace	7.5	7.6	0.65	496	117	186	3.8	—	0	37	1985	11	1.0	0.05	1.95	30	1720	2570*	2950
26-811	9/6/72	Trace	7.3	—	1.9	516	119	96	5.5	0.71	0	219	1650	25	1.0	1.4	0.99	180	1780	2720	2976
26-870	15/6/72	>5.0	7.5	7.5	1.4	620	138	190	4.8	2.05	0	196	1670	481	1.1	0.01	1.80	151	2120	3540	4022
26-1198	13/2/68	—	—	7.2	7.75	—	—	—	—	—	—	—	—	4	—	—	—	282	800	—	—
26-1352	28/11/72	—	—	7.1	29	564	53	21	1.4	—	—	318	1350	44	—	<0.01	0.23	261	1680	2280	—
26-1478	19/7/72	0.0	7.0	7.1	2.2	412	55	15	2.7	0.19	0	361	892	10	0.4	<0.01	0.18	296	1260	1740	1908
26-99983	28/4/64	—	—	7.2	10.5	—	—	—	—	—	—	695	182	33	—	Trace	—	570	724	910*	—
26-99987	28/4/64	—	—	7.9	1.60	—	—	—	—	—	—	317	43	9	—	2.0	—	260	330	370*	—
26-99993	28/4/64	—	—	7.0	0.62	—	—	—	—	—	—	537	492	23	—	0.20	—	440	930	1190*	—
26-99999	23/11/72	—	—	7.0	0.10	256	75	36	13	—	—	478	408	218	—	7.2	0.51	392	950	1240	—

*Computed

Table 2. Laboratory Analyses—Bedrock Wells

Sample or Well No.	Date	H_2S at Field	pH at Field	pH at Lab	Constituents in milligrams per litre (mg/l)												Sodium Adsorbtion Ratio	Alkalinity as mg/l $CaCO_3$	Total Hardness as mg/l $CaCO_3$	Total Disolved Solids mg/l	Specific Conductance (micromhos at 25°C)
					Total Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Boron (B)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (N)					
26-1	9/11/72	—	—	7.2	1.4	512	39	15	3.4	—	—	315	1186	20	—	0.25	0.17	258	1440	2000	—
26-9	28/11/72	—	—	7.3	0.85	524	61	28	2.4	—	—	310	1330	33	—	0.05	0.31	254	1560	2320	—
26-30	18/7/72	Trace	7.2	7.1	4.5	576	184	140	5.6	1.2	0	234	2104	42	—	0.21	1.30	192	2200	3570	3482
26-40	15/6/72	2.0	7.7	7.2	4.5	504	301	145	6.9	1.38	0	258	2323	12	1.4	<0.01	1.26	212	2500	3890	3889
26-65	16/6/72	Trace	7.7	7.1	6.4	500	131	225	8.0	2.14	0	34	2000	95	1.4	0.01	2.31	28	1790	3230	3268
26-91	15/6/72	Trace	7.2	7.3	8.2	336	502	217	16	0.69	0	456	2650	18	1.4	0.20	1.75	374	2920	4870	4496
26-95	15/6/72	>5.0	7.0	7.2	0.95	180	236	82	7.8	<0.25	0	717	805	63	0.8	<0.01	0.95	578	1420	1820	2296
26-125	13/6/72	2.0	7.5	7.3	0.30	420	48	19	2.7	0.23	0	365	875	41	0.4	0.01	0.23	299	1250	2110	—
26-138	18/7/72	>5.0	7.3	7.3	0.40	580	26	15	3.0	0.33	0	376	1031	33	—	<0.01	0.17	308	1560	1990	2133
26-218	6/6/72	Trace	7.5	—	0.75	540	180	391	8.7	1.80	0	54	2000	590	1.2	0.11	3.72	45	2090	4150	4800
26-227	18/7/72	>5.0	7.6	7.8	4.8	547	109	209	3.7	1.10	0	85	2079	36	—	<0.01	2.13	70	1820	3350	3308
26-258	18/7/72	0.3	7.5	7.6	0.50	593	106	235	6.4	1.5	0	44	2209	43	—	0.01	2.33	36	1920	3600	3527
26-260	13/2/68	—	—	7.5	1.98	—	—	—	—	—	—	—	—	3	—	—	—	234	964	—	—
26-264	13/6/72	0.0	7.0	7.7	0.25	184	41	13	17	0.14	0	383	290	28	0.2	4.1	0.23	314	630	1230	—
26-293	14/6/72	0.0	6.7	7.0	0.25	228	200	116	5.9	0.37	0	676	960	53	1.1	1.5	1.35	554	1390	2070	2466
26-298	20/7/72	0.1	6.9	7.5	<0.05	96	28	12	2.1	0.06	0	315	66	20	0.2	9.5	0.28	258	352	500	715
26-303	14/6/72	0.0	7.0	7.2	0.10	128	32	26	5.1	<0.13	0	293	81	57	0.1	9.2	0.53	240	450	630	853
26-311	15/6/72	0.0	7.4	7.1	6.8	524	165	102	4.2	0.67	0	178	1950	12	1.4	0.05	1.00	146	2000	2970	3083
26-314	15/6/72	0.0	6.7	6.9	3.9	560	354	121	5.4	0.64	0	460	2525	14	1.8	0.01	0.99	377	2860	4190	3872
26-338	20/7/72	0.1	7.0	7.0	4.5	560	271	82	4.6	0.46	0	491	2197	9	1.2	0.02	0.71	402	2520	3840	3809
26-343	13/6/72	0.0	7.0	7.3	0.60	360	48	49	2.3	0.23	0	300	850	66	0.3	<0.01	0.64	246	1100	2100	—
26-348	18/7/72	Trace	7.6	7.1	13	569	140	124	3.1	0.62	0	185	2050	24	—	0.10	1.21	152	2020	3370	3307
26-349	14/6/72	Trace	7.0	7.5	3.3	140	160	78	3.7	0.22	0	646	587	33	1.4	<0.01	1.07	530	1010	2010	—
26-364	8/6/72	0.0	6.7	—	5.5	588	104	41	6.8	0.99	0	357	1550	8	0.7	0.05	0.41	293	1900	2660	2752
26-373	14/6/72	Trace	7.2	7.3	0.05	336	32	12	2.4	0.26	0	334	579	28	0.3	13	0.17	274	970	1390	1575
26-425	19/7/72	Trace	7.0	7.3	0.20	384	17	13	1.8	<0.02	0	329	714	21	0.6	0.13	0.18	270	1030	1430	1647
26-443	14/6/72	1.0	7.5	7.3	0.25	624	36	9	2.2	0.38	0	304	1325	13	0.8	0.01	0.09	249	1710	2300	2372
26-448	19/7/72	Trace	7.2	7.0	0.10	576	59	11	3.1	0.27	0	366	1259	14	—	4.2	0.12	300	1680	2340	2407
26-479	13/6/72	0.0	7.3	7.3	1.7	96	88	42	3.0	<0.10	0	533	136	71	0.9	0.04	0.74	437	600	940	1280
26-534	13/6/72	0.0	7.0	7.1	<0.05	132	119	51	4.1	<0.10	0	618	230	125	0.5	7.9	0.78	506	820	1380	1740
26-592	12/6/72	2.0	7.7	6.9	70	320	534	231	7.2	0.36	0	296	3100	65	1.1	<0.01	1.84	243	3120	5520	—
26-603	13/6/72	2.0	7.5	7.7	0.10	56	7	1	0.2	<0.10	0	152	37	3	0.6	<0.01	0.03	125	168	320	—
26-604	12/6/72	0.0	6.8	7.0	1.9	180	109	63	5.3	<0.10	0	610	500	5	0.3	0.02	0.91	500	900	1410	1649
26-634	17/7/72	0.0	7.3	7.3	<0.05	264	19	24	2.8	0.12	0	332	425	35	0.1	2.0	0.38	272	740	1060	1326
26-677	19/7/72	0.3	7.2	7.3	3.8	492	36	8.1	2.0	<0.02	0	341	1053	14	—	<0.01	0.09	280	1380	1950	2086
26-752	28/11/72	—	—	7.3	<0.05	224	68	14	2.9	—	—	423	407	25	—	7.0	0.21	347	770	1030	—
26-763	8/6/72	2.0	7.0	—	2.9	508	122	318	28	3.60	0	230	1800	287	1.1	<0.01	3.29	189	1770	3340	3888
26-768	8/6/72	>5.0	7.8	—	0.55	360	100	118	5.1	0.38	0	78	1260	27	1.5	<0.01	1.42	64	1310	2200	2425
26-777	8/6/72	0.0	7.0	—	1.0	528	53	16	2.2	<0.10	0	301	1250	8	0.6	3.8	0.18	247	1540	2230	2286
26-788	17/7/72	0.0	7.4	7.3	0.45	656	209	139	4.5	0.80	0	266	2400	53	1.4	0.04	1.21	218	2500	4150	3828
26-835	7/6/72	Trace	7.0	—	<0.05	68	88	20	14	<0.10	0	455	133	15	0.8	0.03	0.38	373	530	640	947
26-855	15/6/72	2.0	7.5	7.3	1.1	564	48	14	2.8	0.38	0	306	1275	17	0.4	0.01	0.15	251	1610	2240	2369
26-866	15/6/72	0.5	7.5	7.3	2.2	492	124	174	4.4	0.50	0	77	1875	47	11.2	0.29	1.81	63	1740	3040	3124
26-876	13/6/72	0.0	7.0	7.2	0.40	108	141	82	5.2	<0.10	0	857	215	41	1.5	3.0	1.22	703	850	1280	1740
26-885	13/6/72	0.0	6.5	7.1	0.30	68	14	9	10	<0.10	0	219	47	16	0.1	1.7	0.26	180	228	440	520
26-922	20/7/72	>5.0	7.6	7.9	79	120	77	148	5.3	0.66	0	600	381	246	1.2	0.01	2.59	492	760	1140	1839
26-934	14/7/66	—	—	7.5	0.73	—	—	—	—	—	—	—	—	449	1.4	—	—	438	820	—	—
26-998	20/7/72	0.0	7.5	7.6	0.15	76	25	30	6.9	0.29	0	214	114	58	0.4	0.31	0.76	176	294	490	720
26-1050	12/6/72	0.0	7.0	7.3	0.30	104	95	44	16	<0.1	0	500	213	77	1.0	4.6	0.75	410	650	1070	1388
26-1056	19/7/72	>5.0	7.3	7.8	2.3	200	112	178	15	2.6	0	375	813	192	1.9	<0.01	2.50	308	960	1800	2361
26-1057	12/6/72	1.5	7.0	7.2	1.6	136	168	94	6.0	0.28	0	699	581	37	0.4	0.06	1.27	574	1030	1710	1973
26-1101	19/7/72	Trace	8.0	8.2	3.3	34	56	38	4.7	0.12	0	339	89	32	0.6	<0.01	0.93	278	316	470	773
26-1114	14/6/72	Trace	7.2	7.4	1.5	128	68	23	2.5	<0.25	0	439	84	89	0.5	0.06	0.41	360	600	740	1077
26-1130	19/7/72	Trace	7.1	7.3	2.8	125	76	56	2.7	0.10	0	612	220	28	0.6	0.01	0.97	510	624	870	1289
26-1134	12/6/72	5.0	7.0	7.1	0.40	248	127	66	6.1	0.80	0	473	875	10	1.6	<0.01	0.85	388	1150	1830	2048
26-1146	14/6/72	Trace	7.0	7.1	0.97	156	114	45	12	0.62	0	536	240	86	0.8	11	0.67	440	860	1090	1480
26-1177	3/3/71	—	—	7.4	1.7	—	—	—	—	—	—	556	77	85	—	—	—	456	664	730*	—
26-1193	20/6/72	0.1	7.3	7.4	<0.05	87	17	21	4.9	0.14	0	280	66	36	0.4	1.2	0.54	230	290	430	678
26-1199	12/6/72	2.0	7.3	7.3	0.75	144	56	25	7.8	0.89	0	383	290	22	1.9	0.01	0.45	314	590	980	1106
26-1220	20/7/72	0.0	7.5	7.4	<0.05	176	15	4.5	1.4	<0.02	0	412	148	17	0.7	3.1	0.09	338	500	640	906
26-1292	18/7/72	Trace	7.6	7.3	6.1	569	162	217	6.3	1.3	0	90	1891	297	—	<0.01	2.07	74	2100	3500	3770
26-1347	18/7/72	>5.0	7.6	7.8	5.3	184	124	94	3.9	0.67	0	449	728	14	—	<0.01	1.31	368	980	1430	1768
26-1355	18/7/72	>5.0	7.7	7.5	2.4	561	174	178	6.6	1.0	0	129	2269	29	—	0.06	1.68	106	2120	3640	3556
26-1363	8/6/72	0.0	7.0	—	0.15	192	120	110	5.7	0.24	0	302	605	144	0.6	37	1.53	248	970	1710	2167
26-1429	1/4/71	—	—	—	—	197	20	19	3.0	—	—	363	240	55	—	0.03	0.34	298	574	795	—
26-1471	28/11/72	—	—	7.2	0.25	576	58	23	4.4	—	—	310	1410	11	—	0.30	0.24	254	1680	2440	—
26-1506	19/7/72	Trace	6.9	7.3	<0.05	466	23	5.6	2.4	0.19	0	268	1000	4	—	0.63	0.07	220	1260	1800	1930
26-1558	3/3/71	—	—	7.8	0.10	—	—	—	—	—	—	356	185	21	—	—	—	292	544	620*	—
26-1561	3/3/71	—	—	7.6	6.1	—	—	—	—	—	—	527	185	46	—	—	—	432	772	860*	—
26-1564	3/3/71	—	—	7.6	1.2	—	—	—	—	—	—	275	270	26	—	—	—	226	656	870*	—
26-99982	14/6/72	0.0	7.2	7.2	<0.05	416	16	8	2.8	0.27	0	279	760	15	0.5	1.0	0.10	229	1110	1610	1755
26-99991	12/6/72	0.0	7.0	7.1	0.10	112	44	21	2.3	<0.1	0	393	109	27	0.3	7.0	0.43	322	460	800	950

*Computed

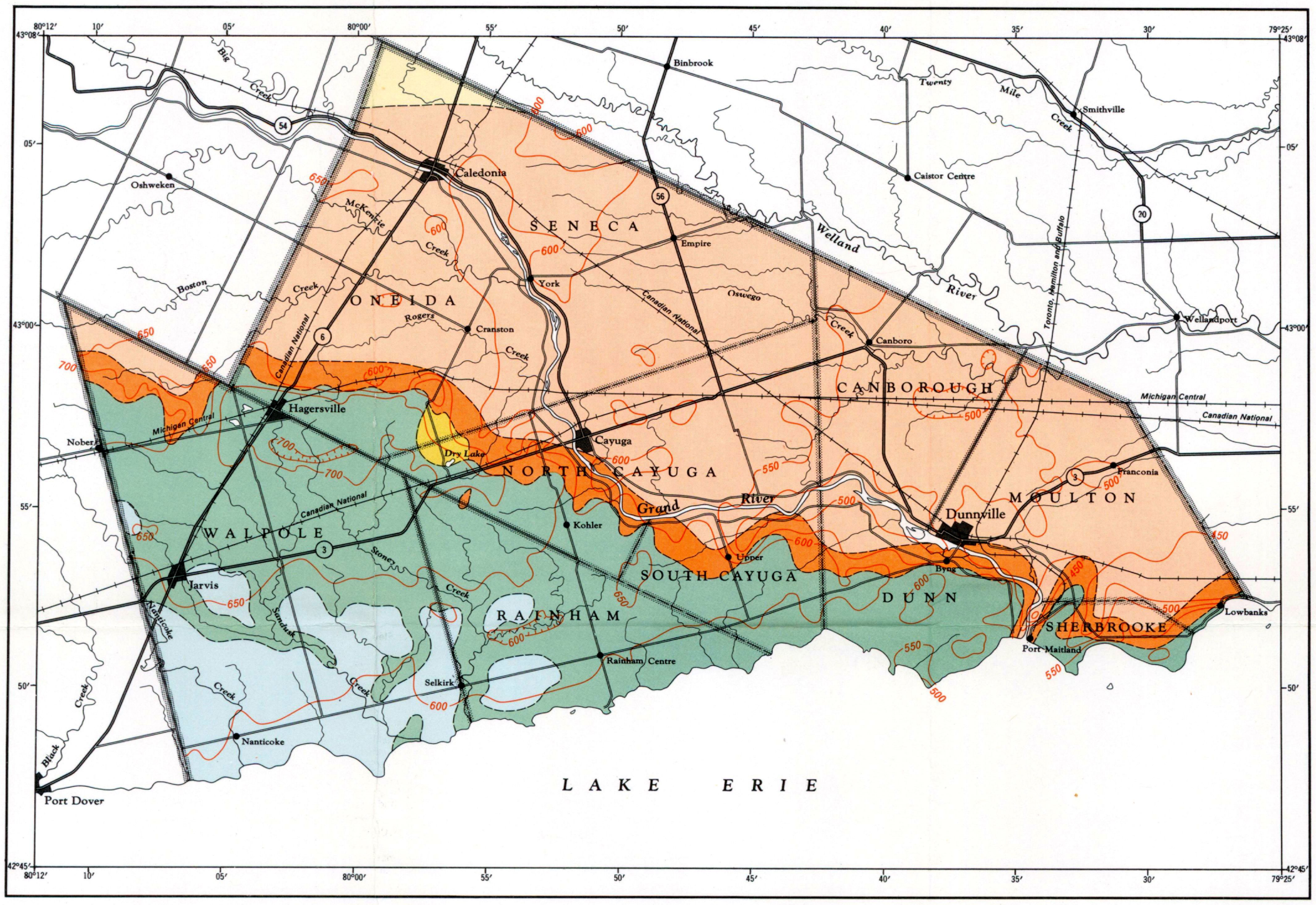
Table 3. Comparison of Water Quality in Different Aquifers

Aquifer Type	Number of Wells Sampled	PH at Field	pH at Lab	Number of Wells Reporting H_2S	Percentage of wells having concentrations in milligrams per litre in excess of the values shown for each parameter and number of sample analyses						Percentage of wells having total dissolved solids in mg/l for the ranges shown			
					Iron as Fe 0.3*	Boron as B 1.0*	Sulphate as SO_4 250*	Chloride as Cl 250*	Fluoride as F 1.0**	Nitrate as N 10.0*	Less than 500	500-2500	Greater than 2500	No. of Analyses
Overburden	20	6.7-8.0 (14)	7.0-7.9 (15)	8 (14)	90 (20)	38 (13)	89 (19)	10 (20)	46 (13)	0 (19)	5	32	63	(19)
Bedrock														
Devonian (Bois Blanc, Dundee formations)	33	6.5-8.0 (26)	6.9-8.2 (31)	16 (26)	66 (32)	4 (26)	35 (31)	33 (33)	33 (27)	4 (27)	16	78	6	(31)
Bass Island Formation	11	6.7-7.6 (11)	7.0-7.8 (11)	7 (11)	36 (11)	0 (11)	91 (11)	0 (11)	11 (9)	9 (11)	0	100	0	(11)
Salina Formation	28	6.7-7.8 (24)	7.0-7.8 (22)	17 (24)	75 (28)	33 (24)	100 (28)	11 (28)	67 (15)	4 (28)	0	43	57	(28)

* Value of permissible criteria for public water supplies

** Value of desirable criteria for public water supplies

(29) Number of analyses for particular parameter



MAP 3112-2

BEDROCK GEOLOGY AND TOPOGRAPHY

LEGEND

PALAEOZOIC

DEVONIAN

MIDDLE DEVONIAN

- DUNDEE FORMATION: brown limestone and chert.
- BOIS BLANC FORMATION: cherty limestone.

LOWER DEVONIAN

- ORISKANY FORMATION: grey sandstone.

SILURIAN

UPPER SILURIAN

- BASS ISLANDS FORMATION: brown dolomite.
- SALINA FORMATION: dolomite, shale, gypsum.

MIDDLE SILURIAN

- GUELPH FORMATION: Buff dolomite.

- Geological boundary, approximate.
- 650 Bedrock surface contour, interval 50 feet

Note: Elevations in feet above mean sea level.

SOURCES OF INFORMATION

Bedrock geology and topography after Hewitt and Liberty, 1972; Sanford, 1969; Sanford, 1954; modified by A. A. Mellary, 1974.

References:

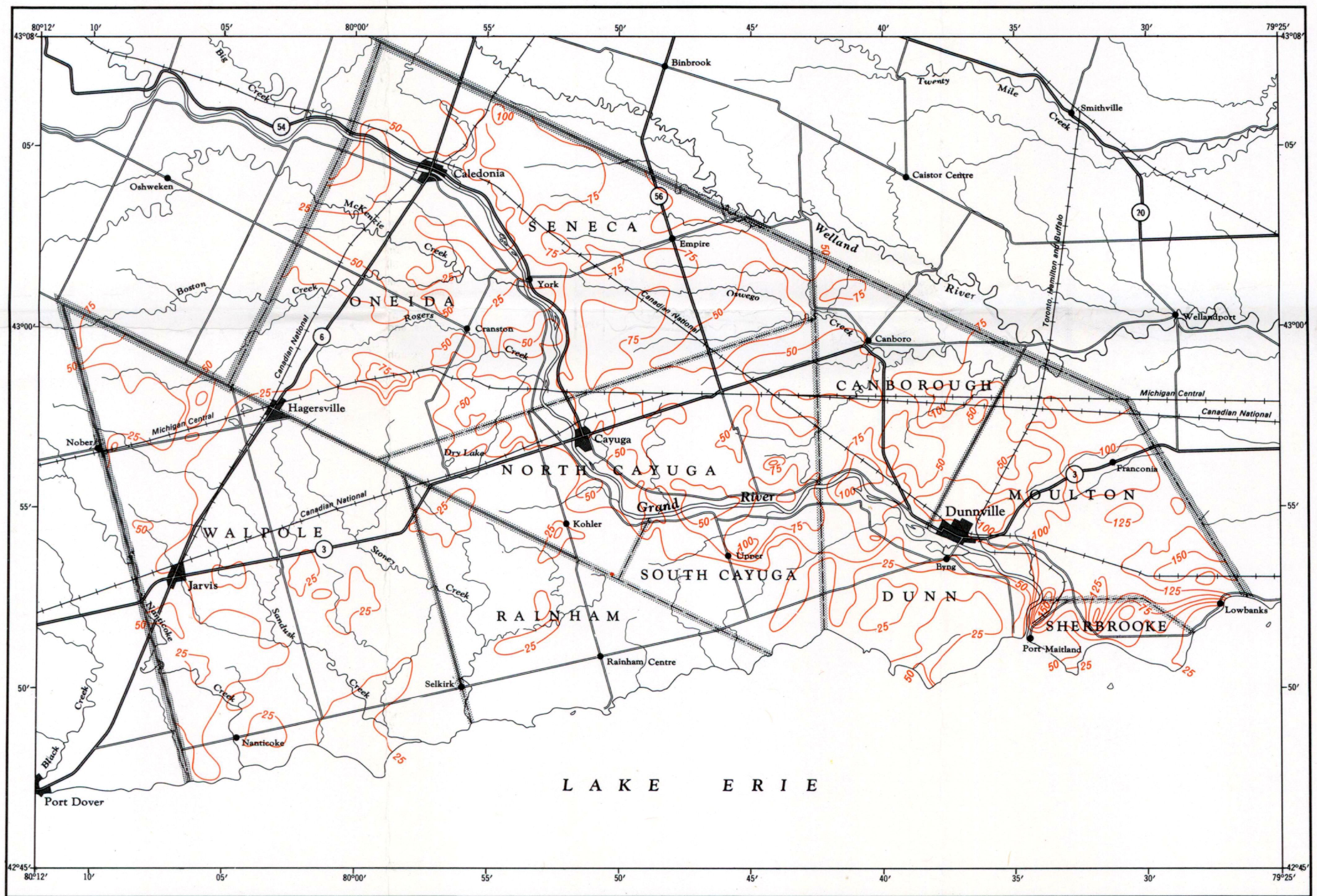
Hewitt, D. F. and Liberty, B.A., 1972, Paleozoic geology of Southern Ontario; Ontario Ministry of Natural Resources, Map 2254.

Sanford, B.V., 1954, Haldimand County and parts of Brant, Wentworth and Lincoln counties, Ontario; showing drift-thickness and bedrock contours; Geological Survey of Canada, Map 53-30.

Sanford, B.V., 1969, Geology of the Toronto-Windsor area, Ontario; Geological Survey of Canada, Map 1263 A.

Base map derived from 1:25,000 and 1:50,000 sheets of the National Topographic Series, and from Ontario Ministry of Transport and Communications maps.

Cartography by R. Zimmermann, 1974.



MAP 3112-3

THICKNESS OF OVERBURDEN

LEGEND

- 75 Line of equal overburden thickness, interval 25 feet.

SOURCES OF INFORMATION

References:

Sanford, B.V., 1954, Haldimand County and parts of Brant, Wentworth and Lincoln counties, Ontario; showing drift-thickness and bedrock contours; Geological Survey of Canada, Map 53-30.

Well information from:

Water-well records on file with the Ontario Ministry of the Environment.

Oil and gas-well records published by the Petroleum Resources Section of the Ontario Ministry of Natural Resources.

Base map derived from 1:25,000 and 1:50,000 sheets of the National Topographic Series, and from Ontario Ministry of Transport and Communications maps.

Cartography by R. Zimmermann, 1974.

Ontario

MINISTRY OF THE ENVIRONMENT

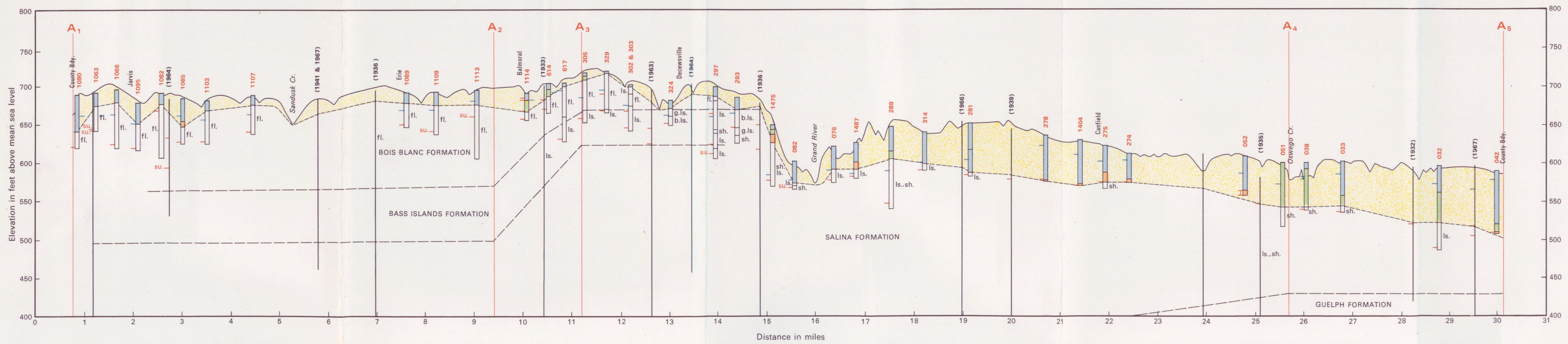
Water Quantity Management Branch

COUNTY OF HALDIMAND

SCALE 1:250,000

5 0 5 10 Miles

5 0 5 10 Kilometres



CROSS SECTION $A_1 - A_5$

LEGEND FOR CROSS-SECTIONS

- Clay
- Hardpan or clay and stones
- Sand
- Gravel
- Overburden
- Ground level
- Assumed bedrock surface
- Water well, gas well
- Static level
- Depth to water
- Depths to water-bearing zone
- 362 — Water-well number
- (1935) — Oil and gas-well, year of construction

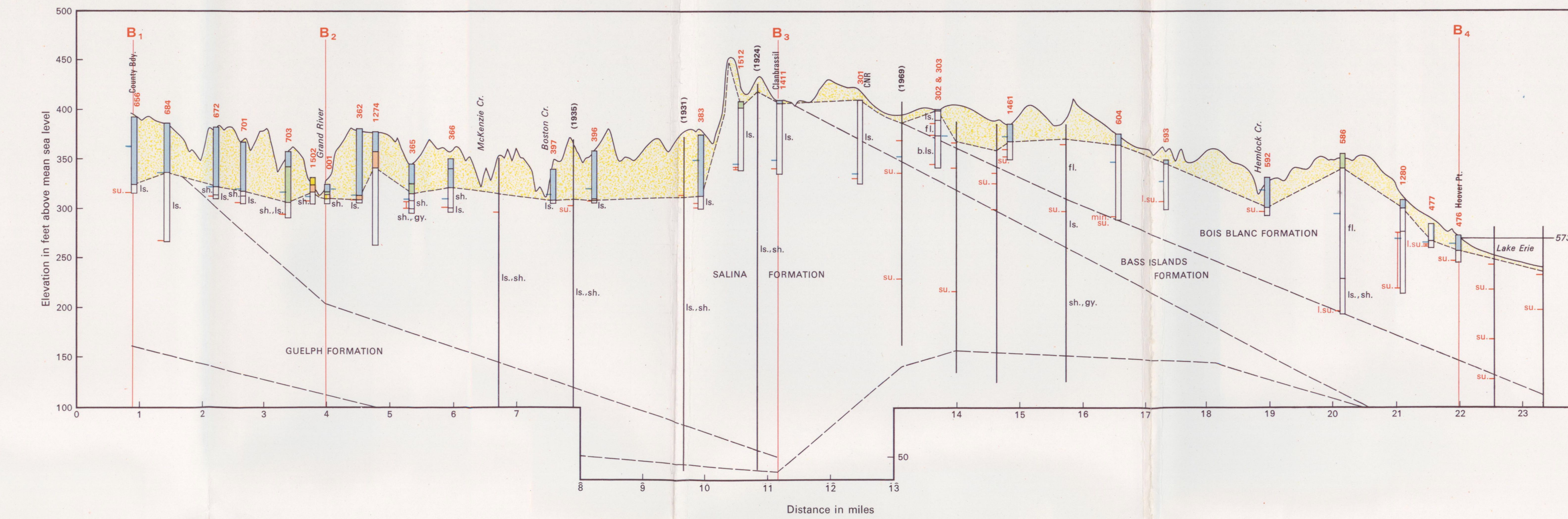
Note: Water level elevation of Lake Erie is the meal annual level.

Horizontal scale 1:100,000

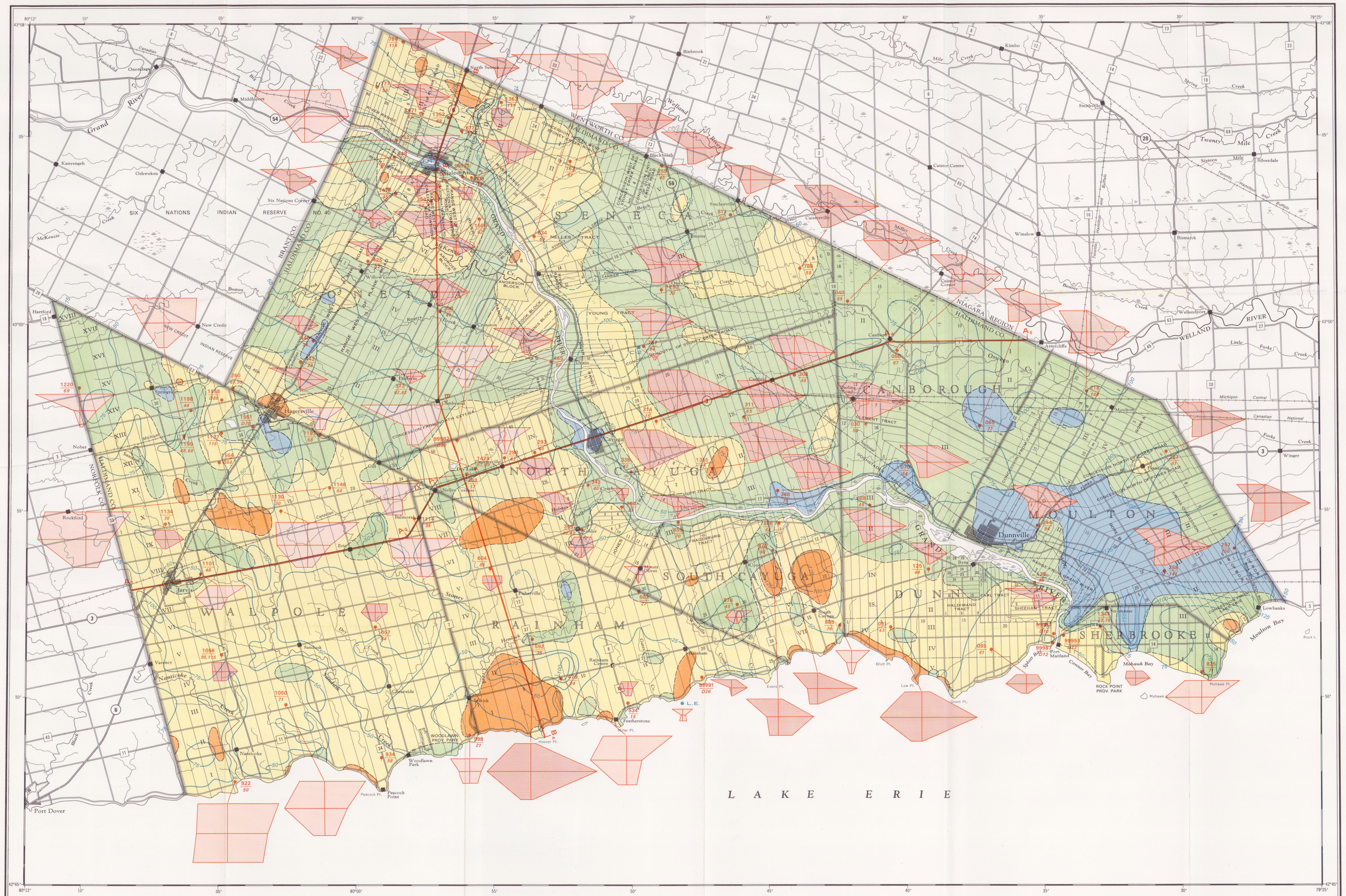
Vertical scale 1 inch = 100 feet

Abbreviations:

b.ls. = brown limestone
fl. = flint
g.ls. = grey limestone
gy. = gypsum
ls. = limestone (undifferentiated)
l.su. = light sulphur
min. = mineral
sh. = shale
su. = sulphur



CROSS SECTION $B_1 - B_4$



Published 1974

Transverse Mercator Projection

LEGEND

Areas where wells are likely to produce less than two gallons per minute. Difficulties are encountered in obtaining sufficient quantities of water for any purpose.

Areas where wells are likely to produce two to ten gallons per minute. Supplies are generally adequate for domestic and stock purposes.

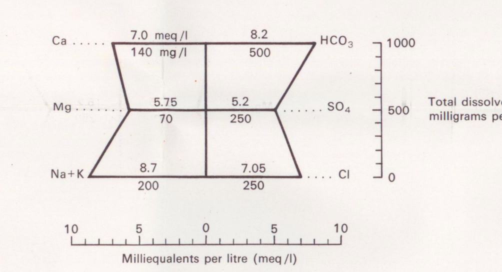
Areas where wells are likely to produce ten to fifty gallons per minute. Supplies are generally plentiful for domestic and stock purposes, adequate for most commercial and small industrial purposes, but poor to fair as a supplemental source for irrigation.

Areas where wells are likely to produce more than fifty gallons per minute. Supplies are generally adequate for most irrigation and many municipal uses.

A_1 A_2 Lines of hydrogeological cross-sections.

WATER QUALITITY DIAGRAM

showing criteria limits



SYMBOLS

Line of equal depth to the deepest aquifer in the overburden or to the upper aquifer in the bedrock, interval 25 feet 50

Assumed depth to the deepest aquifer in the overburden or to the upper aquifer in the bedrock, interval 25 feet 25

Surface water sample (lake, river, cistern) C-2

Overburden well ....

Bedrock well ....

Sample and well number 855
Depth of water-yielding zone in feet 43

Not available .... n.a.

Water quality diagrams:

Concentration to scale ....

Concentration scales reduced; multiply scaled values by five ....
(Generally poorer quality water)

Topographic symbols:

Multilane, limited access highway 401
Provincial highway 78
County road 25
Other road ....
Railway ....
Perennial river or stream ....
Ditch ....
Marsh or swamp ....
County boundary ....
Township boundary ....
City, town or village limit ....
Park or reserve boundary ....
Concession line ....
Lot line ....
Built-up area ....
Centre of settlement ....

SOURCES OF INFORMATION

Probability of ground water by A. A. Mellary and R. Aaltonen, 1973.

Water samples taken by R. Aaltonen, 1973.

Water samples analyzed by the Ministry of the Environment Laboratory and by R. Aaltonen.

Well information from:

Water-well records on file with the Ontario Ministry of the Environment.

Oil and gas-well records published by the Petroleum Resources Section of the Ontario Ministry of Natural Resources.

Base map derived from 1:25,000 and 1:50,000 sheets of the National Topographic Series, and from Ontario Ministry of Transportation and Communications maps.

Cartography by R. Zimmermann, 1974.

Ontario
MINISTRY OF THE ENVIRONMENT
Water Quantity Management Branch

COUNTY OF HALDIMAND

MAP 3112-1

GROUND WATER PROBABILITY

Scale 1:100,000

1 inch equals 1.58 miles

Miles

Kilometres